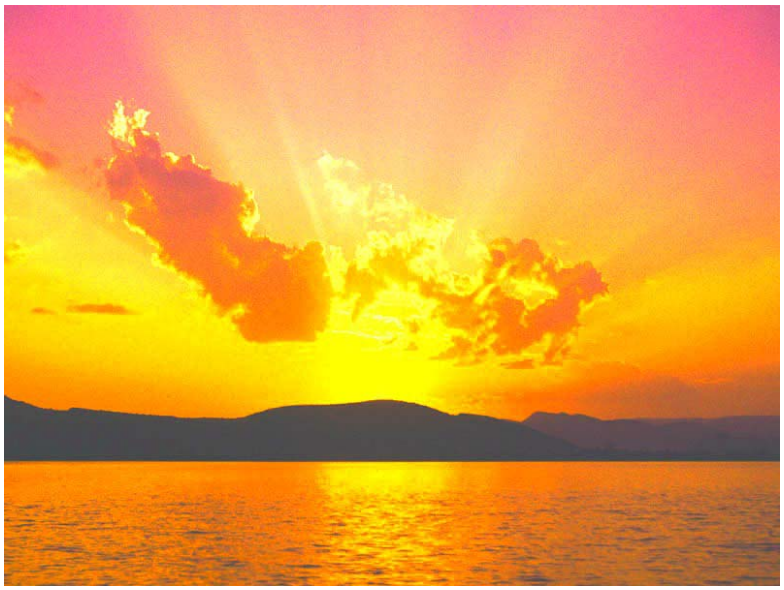
HUDSON TREND ANALYSIS



FINAL REPORT
to the
National Oceanic and Atmospheric Administration

EXECUTIVE SUMMARY
with table of contents and Appendix A of full report

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Preface

Hudson Institute was engaged by NOAA to examine external trends over the next 5-10 years, to assess implications of critical trends for NOAA and to provide an ongoing resource to assist NOAA in understanding and addressing future prospects.

The analysis comes at an especially important time in NOAA's evolution. Since the study started in October 2001, NOAA underwent a change in leadership, went through a major program review, was designated the lead science agency for the President's climate change initiative and began preparing a 2003-2008 strategic plan. Several important pieces of legislation are up for renewal and the Congressionally mandated U.S. Commission on Ocean Policy, a successor to the Stratton Commission that, more than 30 years ago, ushered in profound changes, has been deliberating. The private Pew Oceans Commission effort is underway, the National Academy of Public Administration is undertaking a review of the National Marine Fisheries Service and the National Research Council is examining public/private sector boundary issues with special interest in weather and climate services.

This report provides an overview of a range of trends and sources of change. The emphasis on 5-10 years is intended to encourage and support longer-range and innovative thinking about strategies, policies and programs. Some developments can be expected to be important quickly or are significant today. Others, while making their greatest impacts further out in the future, may require attention in today's decision-making. Implications for NOAA are noted in the summary section and an appendix and are shown in italics in the body of the report.

The study is not intended to make specific recommendations. Rather, it provides a context for NOAA decisions. While the study was initiated before the current strategic plan development process, an important objective is to provide analysis that can be useful in thinking about issues that will arise in the plan and in processes that will follow.

Significant attention is given to technology because of its critical role in NOAA's future. Technology issues and developments are discussed both in a separate section and throughout the study. Focuses of the study include resource management and business trends. NOAA's interest in resource management arises from its many responsibilities for measurement and management and its need to deal with changing pressures, new understanding of problems and changing approaches. Understanding of business trends can help NOAA meet demands for services, interface with evolving types of business organizations and learn from developments in the private sector that may help it to improve its own effectiveness.

The Principal Investigator is Dr. Irving Leveson, Adjunct Senior Fellow and Chief Economic Consultant of Hudson Institute. The study team includes Charles Horner, Hudson Institute Senior Fellow and Dr. Kenneth Weinstein, Vice President and Director of the Hudson Washington Office. Dongmei Zhou and Nazan Riahy provided research assistance.

Hudson Institute wishes to thank the many people inside and outside of NOAA who provided information, comments and suggestions. The study has benefited from discussions with and guidance from Scott Gudes, Tim Keeney, Scott Rayder, Jim Burgess, Jim Cohen, Margaret McCalla and participants in group discussions at NOAA. Special thanks go to Rodney Weiher who served as contract officer for his helpful suggestions and insights. A list of persons interviewed is provided in Appendix D.

The views expressed are those of the authors and need not reflect those of NOAA personnel or agencies or persons contacted in or out of government.

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Executive Summary

MAJOR TRENDS

During the next 5-10 years NOAA will face many powerful trends with far-reaching impacts on its activities and decisions. In discussing these changes, trends are grouped into seven categories. Developments in each of these areas will be critical to NOAA's future and its impact.

- Science, Technology and Communication
- Globalization
- Climate Change
- Demands for Services and Cooperation
- Economic and Business Trends
- Environment and Resource Management Trends and Policies
- Government Initiatives

Within these categories and often cutting across them are many transformational changes such as the Internet, global warming, the new economy, use of incentive and management approaches to resource management, government improvement, reliance on markets and the private sector, security imperatives and patterns of international competition and cooperation.

Helping Society Adapt

In studies ranging from the genetics of brain size in the evolutionary development of human beings to the effects of education on earnings, it has been found that increased rates of change in the environment increase the advantage of skill and cognitive ability.

These traits become more valuable with greater information and analytic tools.

At a time of extraordinary change in many areas, NOAA's services add to society's ability to adapt and succeed.

SCIENCE, TECHNOLOGY AND COMMUNICATION

Technological change has been especially rapid during the last two decades and the pace of change may even be accelerating. As more is applied and its cumulative effects are felt, technology is having increasing impacts on every aspect of society.

Dramatic gains are occurring in microprocessor speed and throughput, bandwidth, storage, compression, networking, wireless and multimedia, embodying both hardware and software. The shift from digital to analog is deepening, last miles of connections are being upgraded, mobility is ever more information-enabled and new devices are proliferating. The power of the Internet is just beginning to be realized.

Exciting developments are occurring in materials technology, biotechnology, medicine, energy, optics, chemistry and other areas along with those in information technology. Tools for creating further progress are evolving rapidly.

With fundamental knowledge expanding, and with so much knowledge being processed with modern information handling techniques, interactions among fields are flourishing. Convergence is occurring both in science and applications.

Developments in information technology will have a wide range of impacts:

- Automation.
- Miniaturization.
- Distributed and mobile activity.
- Determination of formats and other standards more often by the market rather than by government.
- "Programmed human capital" - the ability to embody knowledge in software and systems for ease of use by less skilled or narrowly specialized workers.
- Growth of information services, including bandwidth-intensive multimedia, interactivity and large data sets.
- Data mining.
- Improved sensing, integration of sensor measures and widely distributed monitoring.
- Improved modeling, model integration and resolution.
- Convergence of applications (telephone, cable TV, Internet, game controllers) leading to new services such as Internet telephony.
- Growth of R&D and changes in its nature and composition.
- High levels of capital spending (despite boom-bust cycles).
- Flatter organizational structures.
- Managing based on continuous feedback.
- Self-organizing systems.
- Great diversity of products and capabilities, tailored to diverse needs.
- Shorter life spans of products/high obsolescence and constant adaptation to changing markets.
- Intense competition.
- More frequent restructuring of organizations and their relationships to customers, suppliers, competitors and collaborators as technology and business models evolve.
- Increased difficulty of keeping information private or limiting its distribution.
- Policy challenges involving access, privacy, security, ownership and safety.
- Difficult moral issues in some areas.

The greatest challenges of technology will be social and psychological — adjusting our thinking, speed and direction of response and even willingness to respond, and learning to live in an economy and society that evolves rapidly in new and often unexpected ways.

Government can facilitate diffusion of technologies in which it has a special interest such as transmission of high-resolution images by rapidly deploying the new technologies to create a critical mass of demand. The ability to interface with government at a higher level will give the private sector a greater incentive for rapid and more complete deployment.

Technological change in NOAA has largely been evolutionary rather than revolutionary, in part because of long lead times in budgeting and acquisition for large capital investments. However, discoveries that result from use of technology can have revolutionary consequences. For example:

> The understanding of El Niño, La Niña and the Southern oscillation led to better weather and climate prediction.
>
> The discovery of the hole in the ozone layer led to more attention to global warming and to other environmental issues as well. This contributed to increases in the scale of data collection and research on global change and prospects for additional policy initiatives.

Even if technological change in NOAA systems remains evolutionary, NOAA can expect that there will be important discoveries as a result of scientific advances and persistence with existing technologies that will significantly change the nature of its understanding of the planet and the services it provides.

NOAA will have to manage complex transitions to a new technological environment. For example, expectations are for an increase in satellite data of at least five orders of magnitude or about 100,000 times as much during the current decade and possibly far more. Efforts are under way to assure that the data can be handled in computers, models, storage and communication and overconfidence is being avoided. Most of those with whom Hudson spoke do not expect extraordinary difficulties in NOAA handling the very large quantities of data that are expected, either in processing or storage capacity. Similar challenges have arisen in the past, without abnormal amounts of difficulty.

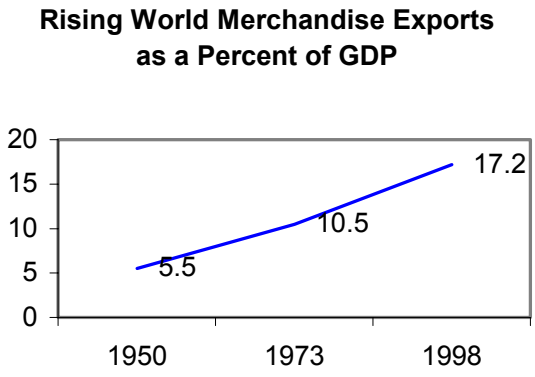
Nevertheless, NOAA will have to be prepared if increases at the high end of the range occur. NOAA also will have to assure that it can handle intervening imbalances between demand and supply of technological capabilities and skills so it can take earlier advantage of opportunities as well as assure smooth transitions in service.

With international capabilities also increasing, NOAA may have greater opportunities to take advantage of foreign efforts for launching satellites, collecting data and/or distributing information.

GLOBALIZATION

Globalization has been associated with:

- Increasing contact through travel, communications and trade.
- Development of a world market for technology.
- Cross-ownership of business and financial assets.
- Growth of reliance on markets vs. regulation, government ownership and central planning.
- Spread of democracy with pressures from exposure to ideas, rising incomes and strengthened business classes.



Beneficial interactions can significantly raise living standards and prevent or overcome problems, including problems that are byproducts of increases in incomes.

The principal implication of rising global interdependence for NOAA and other agencies is the growing importance of international cooperation in science and resource management for achieving results. The burgeoning scope of cooperation among countries and linkages among private organizations creates opportunities to transcend fragmented approaches to data collection, dissemination, research, policy and operations. It also adds enormous complexity as NOAA and constituents seek to understand each other's needs and find ways to work together across numerous geographic, organizational, scientific and cultural dimensions.

The possibility that U.S. global dominance could erode also must be considered seriously. Perhaps the most important consequence of lessened U.S. dominance from NOAA's point of view is the fragmentation that could result in data collection, research coordination and information dissemination. One critical example is European efforts to develop a competitor to the Global Positioning System.

CLIMATE CHANGE

A continuing warming trend is likely to increase public pressures for action. Public concerns may also be increased by shorter-term increases in warming or erratic weather patterns that have little or nothing to do with long run trends, especially if short-term developments are associated with widespread drought or other severe consequences.

However, the public is not likely to be willing to make great sacrifices anytime soon — such as adopting a large carbon tax or prohibiting construction in areas likely to experience extensive flooding if the sea level rises.

Under these circumstances, efforts can be expected to focus on:

- Improving the evidence.
- Developing policies that are less costly or restrictive.
- Finding ways to maintain good international relations despite differences in attitudes and policies between the U.S. and other nations.

Concerns about global climate change will have far-reaching impacts on NOAA's policies, products and operations. Consequences include:

- Accelerating attention to ecosystem approaches that transcend previously segmented areas of measurement, research and prediction. For NOAA this includes:
  - More complete observation of oceans.
  - Integration of observations and analyses of behavior of oceans, atmosphere and land.
- Support for larger scale scientific approaches and major investments that address the concerns. This includes the extensive use of more types of and more powerful sensors on remotely operated vehicles (ROV's), autonomous unmanned vehicles (AUV's) and satellites, and investments in supercomputing.
- Increased demands for both observations and forecasts, including more measurement of climate change generally, water flows, air quality and space weather and more forecasts of societal consequences of observations and analysis.
- Greater pressure for NOAA to develop "products" that can assist in understanding the nature of the threats, facilitating research and planning by other organizations and providing support to the public policy process.
- More regional and local data and management, including much higher resolution weather and climate data and more complete counts of marine species and their movements.
- Greater cooperative efforts to improve and coordinate ocean policy.
- Pressure for interagency cooperation to more effectively utilize resources and make better use of information.
- Influences of government-wide efforts to reallocate research budgets related to climate change.
- Improvements in international cooperation in addressing observed consequences of climate change.
- Continuing tension between approaches that emphasize science vs. those that emphasize precaution.

Over the next decade, advances in technology and further deployment of existing technology will make it possible for NOAA to provide a larger set of environmental data and to provide more continuous and high resolution data in all kinds of weather. Integration of disciplines will be necessary for many information products.

Climate change research will become more well-rounded, integrating considerations of glaciers, atmospheric chemistry and ecosystems, and including a capacity for ecosystem forecasts that is independent of global warming. It will take some time before a full climate model of the U.S. can be

developed.

Because of the focus in the scientific community on global warming, climate change research can be expected to give particular attention to ways in which warming impacts may be intensified, for example by causing oceans to hold less CO_2, contributing to further warming. Interest will be more heavily focused on mechanisms that can contribute to extremes of warming than on those that can modify a warming trend or produce cooling.

NOAA increasingly will be involved in assessing the potential and the after-the-fact impacts of policies to moderate the effects of climate change. NOAA capabilities could play an important role in monitoring and analyzing outcomes of international participation in the Kyoto protocol.

The U.S. will be under continuing international pressure to curb its use of fossil fuels. The debate over responsibilities of high-consumption developed countries and the leeway to be given to developing countries will never fully be resolved. The debate over use of incentive approaches vs. command and control approaches to environmental management also will be ongoing because of international differences in how the approaches are viewed.

DEMANDS FOR SERVICES AND COOPERATION

Concern over weather patterns will raise demand for weather and climate forecasts, coastal, ocean and atmospheric observations and for efforts to protect coastal communities and prepare for evacuations. It will raise issues of changing patterns of species migration, including non-native species and threats to species. It also will generate greater interest in alternative energy sources, including those from the sea.

The imperative of educating the electorate and providing the foundation of knowledge that can guide new generations, both in the U.S. and internationally, is stronger than ever. NOAA can contribute further to understanding by encouraging its knowledge relating to the environment to be made available to publics as well as to scientists in other countries.

NOAA will be called on to provide more data in support of regulation and to expand some regulatory functions as interest in climate change grows.

Air quality will be a growing effort within NOAA, involving collecting, analyzing and distributing information. Data will be collected on a growing number of subjects — such as CO_2, aerosols, nitrogen deposits and atmospheric density.

Demand for more kinds of and better environmental information such as air quality will in part be driven by the heightened concern of the large and politically important baby boom generation for matters of health and safety. Another motivating factor is the general rise in demand for comforts and aesthetics with greater affluence.

The importance of water issues and associated political/military repercussions and the interplay of water with land and atmosphere imply a need for increased attention to hydrologic measurement and analysis.

NOAA will be asked to increasingly accommodate the desire for rapid selection and automatic distribution of information in appealing forms, whether provided directly to end users or through intermediaries. The development of self-describing data sets will be an important tool in that effort.

A consequence of the use of technology by consumers is “swarming” or surges in demand from many participants. In one formulation “smart mobs” linked by high-tech communications devices act in concert to rapidly move to the same activities or destinations. The implication of swarming for NOAA is that it is necessary to be ready for very high levels of peak demand.

Many demands will come from the needs of specific industries such as energy and insurance. The telecommunications industry could become a large consumer of NOAA information in the future, with solar storms and other phenomena having a great influence and with wireless communication growing rapidly.

A large rise in energy prices would raise demand for weather and climate services from power producers and distributors and from industrial and commercial energy customers interested in managing supplies, buying before price increases, locking in prices in contracts, and hedging and trading on energy markets.

NOAA increasingly will be providing climate and environmental information for regional and local areas. NOAA may play any number of roles in processes to develop operational forecasts, directly providing information, working with universities, regional consortia and private firms and/or serving as a catalyst for local efforts. In any of these roles, NOAA will be central to the development and operation of a regional system.

NOAA has had increasing calls for information about other countries to help other Federal agencies and international organizations in relief efforts. It can expect greater demands from other agencies and requests for information that is increasingly international.

NOAA will collaborate more with the military in development of space and ocean capabilities, engaging in more joint efforts and situations where the military is the customer. It will sometimes compete with the military for resources or control of programs and more often couch requests in national security terms. Its measurement efforts will go beyond support for military operations to include assessment of environmental and commercial impacts of war.

The missile defense initiative can give a major impetus to satellite development. NOAA could be called upon for data services, monitoring and research, satellite rescue and other activities.

NOAA could face increased demands for services and play an expanded advisory role in disaster prevention and response.

- NOAA could bring to bear information, research and analytic capabilities to assess how spread of contamination would be affected by weather and ocean conditions. Valuable contributions can be made by predicting or tracking effects of winds or currents in distributing harmful substances or organisms.

- Nuclear contamination would create particularly challenging, far-reaching and long-term challenges. It would require extensive interagency and potentially international coordination.

- NOAA's skills can assist in locating the sources or origins of some contaminants as well as their impacts.

Increased demands for information to support military and homeland defense could lead to patriotic and security-motivated demands for greater U.S. self-sufficiency in data collection. Concerns about security could lead to restrictions on research, information-sharing and international collaboration at the same time as some aspects of research and collaboration are encouraged.

ECONOMIC AND BUSINESS TRENDS

Economic Trends

The bust in capital spending after the boom of late 1990s left industry with excess capacity and weakened many leading technology companies. Working off excesses will take several years. In the meantime it will be harder for NOAA to rely on the private sector for investment and technology in satellites. There also will be slower introduction of some communications technology since introduction often comes as part of new capital investment. However, slowing of the introduction of technology will be selective and temporary.

The "new economy", although tempered, remains very much alive. It is morphing into a more traditional high growth period that, when it arrives, will be more sustainable and stable.

The extended economic slowdown, bear market in stocks, telecommunications implosion and collapse of many dotcoms, along with effects of September 11, 2001 raised serious questions about how quickly and fully the U.S. and global economies would recover and whether any resumption of rapid growth could persist. However, there are strong underlying positive factors. Most significantly, despite the sharp decline in capital spending, new technologies and products continue to be introduced at an unusually rapid pace.

Economic growth and productivity are not expected to maintain the pace of the boom years. However, new economy influences of rapid technological change, intense competition and opening of global markets will bring significantly higher growth during the coming decade. Sustainable U.S. productivity is expected to be higher by about 1% per year than in the two decades prior to the mid-1990s acceleration, nearly double the earlier rate.

Implications of sustained rapid technological change and renewal for business and the economy include:

- A need for government to become more business-like — to be decisive, focused on products, performance and customers and open to many ways of getting things done.
- A need to rely heavily on resources, capabilities and the diversity of sources in the private sector to respond effectively to rapidly changing prospects and opportunities.
- Greater need for open markets, along with appropriate oversight.
- More competition among technology standards so as not to prematurely lock in one standard while others that may be superior need some time to develop.
- Intense competition and a shorter half-life of monopolies.
- Many big winners and big losers among prominent companies.

Gains from the new economy will be associated with:

- Creation of new markets, uses, customers and associations among individuals and groups through widespread use of both general and specialized information and communications systems.
- Growth of markets and demands for information through rising incomes.
- More rapid obsolescence of technology, but also more opportunities to introduce new technology rapidly as heavy investments are made to support growth.
- Expanded opportunities for scientific cooperation.
- Increased pressure on the environment if the global economy grows more rapidly, but also greater knowledge, incomes and technological opportunities for solutions.
- Improved government budget positions, albeit in the context of deteriorated levels.
- More rapid deployment of high bandwidth but also greater increases in demand.

Some of the gains from the new economy will be offset by influences of the “dis-economy.” We use the term "dis-economy" to refer to a series of recent and emerging developments that collectively exert a significant drag on the economy. These include restrictions and costs associated with terrorism, the war on terrorism and homeland security, the crisis of confidence in business ethics and its manifestations, increased interferences with the information economy (hacking, spam, viruses) and various increases in regulation.

The dis-economy operates at the same time as the new economy. It does not overshadow the new economy, but the net effect of the two forces is significantly less economic growth than would be possible if the new economy influences more fully dominated. Adverse effects are greater in the early portion of the next ten years. Adjustments will lessen adverse effects over time but many forces will be long-lasting and new impediments and disruptions from war can arise.

NOAA will face a continuously tight budget environment. Issues of NOAA's role could be more prominent as agencies compete for limited funds and government is reorganized. Overall budget stringency will require particularly effective efforts to justify expenditures. It will be particularly necessary to demonstrate the benefits to the nation and to do so quantitatively wherever possible. The links between research and development will require greater clarification and strengthening.

Energy is important for many reasons:

- Prices affect demand for weather and climate information.
- Technology and prices affect the scale of deep ocean development.
- International development can engender negotiations over rights and boundaries and environmental impacts.
- Energy can be at the center of tensions that lead to wars, with attendant demands for information and effects on the economy.
- Technologies developed for energy exploration and development, such as remotely operated vehicles, could be very useful for NOAA activities.
- Efforts to induce movement away from reliance on fossil fuels can change the nature and location of energy development and distribution. It also might lead to reduced maintenance or abandonment of facilities, with resulting environmental impacts.
- Technology and prices could eventually lead to large-scale development of undersea methane hydrates.

The long run pattern is for a gradually rising trend of energy prices and large fluctuations around the trend that last for several years. Prices are low relative to their historic range. They are likely to go a lot higher in the decade ahead because of economic growth and political and military vulnerabilities. Far less likely is the possibility of a decline in relative energy prices induced by technology and new sources of supply.

Use of the oceans may increase more rapidly than recent experience suggests. Despite decades-old suggestions for undersea mining, tourism and human habitats, wave power and other uses of the oceans, development has been limited until recently. Growth is now being fostered by technologies for deep-sea oil and gas recovery, by interest in new sources of energy and by interest in a wider array of minerals of potential commercial value. New technologies such as unmanned Slocum Gliders and improved sensors can be expected to expand opportunities for exploration and monitoring as well.

Renewed interest in oceans raises complex issues of international law and diplomacy as competing claims arise. The United States can expect to be drawn into an increasing number of boundary and jurisdictional issues relating to uses of the oceans over the next decade. NOAA will be asked to provide detailed information that can be used to delineate boundaries and chart passageways.

Business Trends

Understanding changes in private organizations can help government meet demands for services, interface with evolving types of business organizations and learn from developments in the private sector that may help it to improve its own effectiveness.

Of the forces are shaping the private sector, technology and especially the information revolution is most pervasive. Other powerful influences include globalization, deregulation and the emergence of a modern service economy, which themselves are profoundly influenced by information technology. Together, these result in extensive competition, automation and in heightened demands for information.

In this environment there is a premium on arrangements for making effective use of information to manage and operate the organization, to link the organization to suppliers, partners and customers and to provide information as a service and a basis for transactions.

For many information and software providers the cost of producing additional unit of each product is zero or near-zero after the initial fixed costs are met, facilitating rapid growth of markets.

Many information products exhibit "network externalities" or "demand-side economies of scale." Such economies arise because the value to each user of participating in the network increases exponentially with the number of participants (“Metcalf’s Law”).

Network externalities make demand for products more price-sensitive since lower prices that add customers lead to even more customers. Economies in production, especially those from low incremental costs of adding users, can interact with demand economies from network externalities to produce rapid growth in the number of users. They also can bring about major changes in ways of doing business.

New types of multi-firm organizational structures have evolved to take advantage of transaction cost efficiencies and opportunities for market growth. Configurations include the "virtual corporation" that directs activities of other entities without having its own production facilities, the focused firm that sticks to its core competencies, strictly out-sourcing for other capabilities, the networked company, in which separate entities act together to produce a result, sometimes in self-organizing systems and business-to-business e-commerce exchanges that create markets centered around an industry or large buyer.

Information technology increases the viability of many smaller organizations as lower costs of inter-firm communication facilitate participation in networks. However, information technology also creates efficiencies within larger organizations by lowering costs of coordinating people and departments. The result is consolidation of firms but at a slower pace, with larger roles for smaller firms than otherwise.

The form and function of the modern organization is evolving to embody many features that are heavily influenced by advances in information technology. Formulations emphasizing various aspects include:

Horizontal Management

> With horizontal management, as emphasized by Peter Drucker, ease of communication means there are fewer layers of management through which communication has to filter.

The Professional Service Organization

> Henry Mintzberg made the distinction between machine bureaucracies that focus on repetitive standardized tasks and professional service organizations in which individuals have greater skill and autonomy in defining and carrying out tasks.

The Network Organization

> The network organization draws extensively on resources in external organizations through arrangements under which participants can acts as a coherent whole.

The Adaptive Enterprise

> The adaptive enterprise adjusts production to information fed from its units and the external environment, increasingly in real-time. Rapid adaptation to current developments is emphasized over planning and forecasting for longer range prospects.

Mass Customization

> Mass customization flexibly allows a wide variety of products and features to be produced and tailored to the customer and at the same time benefits from efficiencies of mass production.
>
> One example of mass customization is efforts to provide localized individual weather information on demand to cars, cell phones and PDAs.

Electronic Marketplaces and Online Distribution

> Electronic distribution of information services, media and financial products facilitates direct contact, transactions and self-service.
>
> New models have begun to develop that incorporate a wider range of services — both in arrangements among the participants and through tie-ins with outside vendors.

An organization may need two kinds of business models for different activities, one for units dealing with longer term changes or more predictable environments and one for those requiring a high degree of feedback and rapid adaptability to external information and developments.

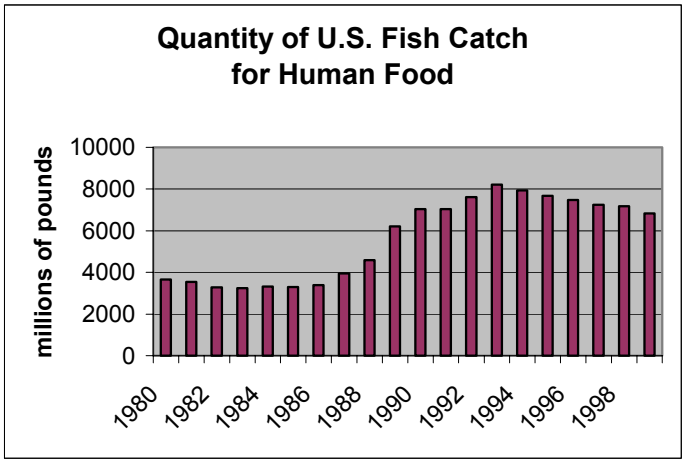
Over the years there have been many formulations of strategic and management models for improving business capabilities and strategic effectiveness. What is changing is the growing urgency of responding to market pressures and to technology through physical, organizational and human resource decisions.

Flatter organizational structures create an issue for managers of how to deal with information overload in an era when they can receive endless messages through email, cell phones and faxes. Ironically, for a decentralized world this is a problem of over-centralization. The traditional way to deal with overload is to decentralize — to delegate more decision-making authority. The ability to delegate in NOAA is closely tied to how well it can recruit personnel and how well it can develop and train the right mix of personnel to enable more decentralized decisions.

The need for managers with both technical and management skills has traditionally been handled by drawing on a mix of people with technical and managerial backgrounds. With technology more complex, the balance is shifting toward greater reliance on technical staff for management. This approach is supported by greater use of information technology and formal processes to channel management efforts.

ENVIRONMENT AND RESOURCE MANAGEMENT TRENDS AND POLICIES

Resource management encompasses the full range of policies and programs dealing with the condition of natural resources. It includes weather and climate as well as air, land and water pollution, fish stocks, endangered species, creation of new species by natural or artificial means, forest management and issues relating to energy and minerals. It addresses government and industry practices, incentives, governance, conservation and regulation.



NOAA's interest in resource management is not only in its main areas of responsibility such as weather and climate, oceans and fisheries — but also in the broader concerns about the planet and in pressures that may affect future responsibilities. Recent heightened concerns about global climate change will have far-reaching impacts on NOAA's policies, products and operations.

NOAA will have to balance concerns about resource management and the environment with those of economic development and security. While these emphases can lead to some actions that coincide, they also can involve very different priorities. Resource management can involve more regulatory functions while economic development looks more to markets and security concerns lead to particular kinds of interventions.

Trends in resource management include:

- Economic development as complementary to environmental improvement rather than as a trade-off in policy-making.
- Ecosystem approach — reflecting interactions among all parts of the ecosystem in place of separate analyses and decisions, and closely related to that,
- Global approach to measurement and science, including:
  - A global ocean observing system.
  - Integration of observations of ocean, atmosphere and land.
  - Much more extensive use of unmanned systems - including sensors in remotely operated vehicles (ROV's) and autonomous unmanned vehicles (AUV's) for ocean systems and satellites.
  - More comprehensive weather and climate modeling.
- Possible expansion of some regulatory roles for NOAA in addition to expanded science and information to support regulation related to ocean and climate change.

Ecosystem Management Implications

- Understanding ecosystem interrelationships and responses to changes.
- Effectively utilizing new technologies and information.
- Evolving newer resource management approaches for application on an ecosystem scale.
- Working extensively with other nations and NGOs.
- Assessing potential and actual outcomes of policies.

- A halting, at least temporarily, of increasing regulation and regulatory costs in society as a whole relating to resource management.

- New regulatory approaches.

    - Favoring regulatory initiatives with the highest benefits relative to costs.
    - Increased use of incentive approaches in regulation.
    - Greater use of management and governance arrangements to bring parties together.
    - Greater reliance on science for policy and regulation.
    - More regulatory reviews of agency actions.
    - The Data Quality Act potentially complicating regulation and scientific staffing.
    - Further use of the precautionary principle outside the United States.
    - Incentive approaches to resource management being adopted less widely in nations that do not place as great a reliance on markets generally.

- Technology providing important solutions to resource management problems, sometimes accompanied by regulation.

- Changing marine demands and responses.

    - Expansion of marine protected areas and marine reserves.
    - Overfishing reduced primarily by limits and only slowly by capacity reduction, while racing with increases in fishing productivity brought about by technology.
    - Limits on fishing continuing to be the main policy tool by which capacity is reduced, with resulting difficulties in moving to a more cooperative model.

- Increased attention to international issues.

    - Renewed U.S. reliance on multinational institutions and networks.
    - Growth of international participation.
    - International policy divergence.
    - Growth of NGOs.
    - Eco-consumption.
    - Increased environmental regulation through trade.
    - "Water and resource wars".
    - Addressing environmental fallout from terrorism and war.

As interest in undersea areas grows, marine regulation increasingly will involve land management, directly or indirectly controlling uses of the seabed that go beyond those prevalent today.

Major gaps will continue to exist between the state of scientific knowledge and the degree of knowledge necessary to make policy. NOAA will be under growing pressure to produce practical results and to extend its analyses to emerging issues in spite of these limitations.

As NOAA and other agencies seek to rely more on science to avoid biases in policy they will have to confront professional opinions that do not always take appropriate account of evidence. Leadership will be required to rely on the most critical evidence even when vocal scientific opinion lags or personal predilections influence conclusions of those who would be looked to for concensus. This has always been an issue in resource management, but its intensified focus in the area of climate change and its role for fisheries management are of particular importance to NOAA.

Effectively maintaining focuses on both science and complex socially-oriented resource management initiatives will present major ongoing challenges.

- Developing and implementing ecosystem approaches and making use of the rapid advances in biotechnology and related fields will require NOAA to utilize many disciplines, including giving much more attention to the biological sciences.

- There will continue to be questions of how organizationally separate science should be from regulation. Closeness can allow science to be more fully used in decisions but open science to greater political pressures. The greater the political pressure, the more important is separation. The greater the ability of science to deal objectively with socioeconomic issues behind the pressures, the more important is closeness.

- The extensive negotiation required by managers employing evolving methods of resource management will necessitate developing skills and organizational structures that go beyond the scientific emphasis that is at the heart of the agency.

- The growth of informal and electronic publication opportunities means that NOAA will have to find the right balance between goals of peer review and more rapid or administrative forms of distribution.

International cooperation carries with it complex demands. Divergent laws, regulations and interests must be reconciled. NOAA will find it necessary to deal with many organizations and to support negotiation efforts with scientific evidence and management capabilities on many issues and across vast distances.

High levels of coordination of disciplines and departments will be needed inside and outside of NOAA for:

- The evolution of management roles along with science roles in science management and regulation
- Development of ecosystem approaches
- Increased international responsibilities

GOVERNMENT INITIATIVES

Policies, Organization and Laws

The Stratton commission was instrumental in establishing U.S. ocean policy and structure more than 30 years ago. That has led to some anticipation that the new commission will have far-reaching effects, even including the possibility of a federal oceans department. Admiral James D. Watkins, U.S. Navy (retired), chairman of the Commission, has been quoted as saying: "We're already assuming that there has to be a national ocean policy coordinating body." In the cover letter to the September 2002 interim report he states: "…policy may well call for new and creative governance mechanisms."

The impact of the Commission on Ocean Policy is uncertain because of the complex climate, but a number of factors could come together with upcoming legislative reauthorizations including the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act, the Coastal Zone Management Act and the Endangered Species Act, along with the influence of the Pew Oceans Commission, to produce significant change.

The Commission on Ocean Policy also has endorsed U.S. accession to the Law of the Sea Convention but more generally support has been weak. It is not clear whether the Commission, by bringing the issue of accession to the Law of the Sea convention into a larger coalition for ocean policy can significantly increase its prospects.

NOAA will have to be ready to address proposals for a range of legislative possibilities and for receiving resulting responsibilities. That will require breadth of management so that current responsibilities will not be compromised and opportunities to use legislative change to chart a course will not be foregone.

The U.S. has been seeking international recognition for the potential of economic development to enable both reduction in poverty and improvement in the environment. NOAA increasingly will be enlisted in making that case and in promoting its understanding in other parts of the world.

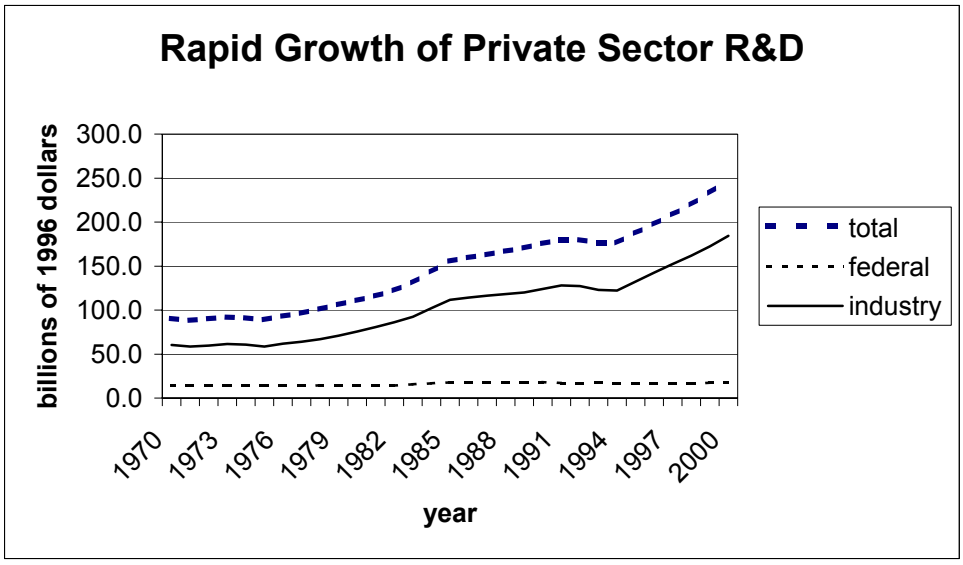
Public/Private Roles and Business Models

Rapid technological change and the evolution of sophisticated organizations and networks are creating growing opportunities for NOAA and government generally to build on the capabilities of firms, research organizations, universities and/or other government agencies.

Increasingly, the question is not what government should do, but what government should take responsibility for. There are many ways in which that responsibility can be provided for.

NOAA can work with new types of organizations in many ways. It can be a catalyst, organizer, partner, owner, member, customer or supplier. NOAA will want to explicitly determine appropriate roles in each circumstance and define ways of managing those roles. Through the many possible forms of involvement, government can facilitate efforts of private organizations to fulfill functions previously performed by government.

Increasingly, the question is not what government should do, but what government should take responsibility for. There are many ways in which that responsibility can be provided for.



Privatization has been limited in the U.S. because of the much smaller role of government enterprises and greater reliance on the private sector generally. The U.S. generally is privatizing "from the bottom up" through detailed reviews of activities, rather than rather than by "top down" efforts that lead to disengaging from entire industries.

Boundaries between the public and private sectors will be shifting as a result of the increasing capabilities of the private sector, its technological sophistication, access to risk capital and the growing scale of firms.

NOAA will be engaged in continual negotiation with the private sector over where boundaries of public activities should fall and how interactions should take place.

Weather services will continue to be a principal area of controversy regarding public/private roles. Similar issues may arise with climate information services. The role of industry self-regulation will continue to be prominent in fisheries management. Other areas, particularly measurement of the local environment such as air quality, will become sources of tension as NOAA expands its activities and as the potential size of the private market becomes more interesting.

Private commercial firms that wish to process and redistribute information will increase pressure on NOAA to provide data in basic forms through automated processes in real time.

NOAA will face growing competitive challenges from the private sector in providing information-related services as government advantages from scale economies are reduced by declines in price and increases in capabilities of equipment and software, and by the continued evolution of large technology firms that can mount sizeable efforts.

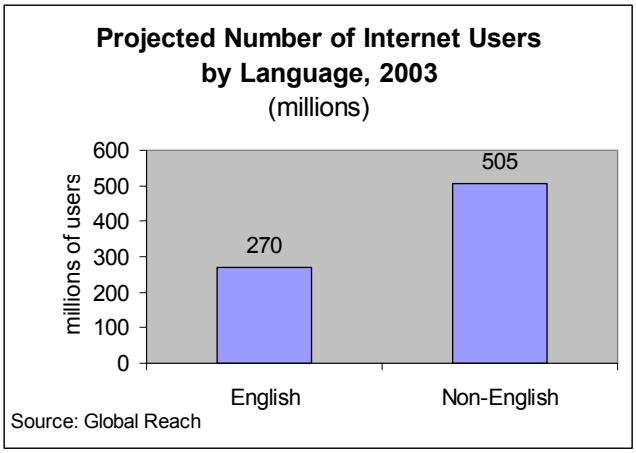
The structure of the business community is being profoundly influenced by the information revolution, with some functions being performed by interlinked specialized organizations rather than being integrated within large organizations. Such networks add to competitive pressures and demands for greater private roles in enhancing and distributing information.

Under these conditions, cooperative discussions of plans and services become essential to avoid contentious and counterproductive relationships as well as to find ways to work together.

NOAA increasingly will have to consider opportunities to work with the private sector where that offers an avenue for modernization and innovation. A tight budget environment could put pressure on NOAA to contract more with the private sector, especially if there are potential costs savings and/or if that is a way to get adequate capital investment and keep up with technology.

NOAA could face more difficult choices between drawing further on resources of the private sector to extend its and the nation's capabilities vs. trying to do more on its own for tighter security.

Electronic Government



NOAA has demonstrated excellence and continued progress in electronic government. Additional possibilities include:

- Moving beyond early stages in developing transaction capabilities.
- Evolving more extensive interagency capabilities for Web and other applications.
- Developing cooperative arrangements with universities, research institutions and private firms to offer the user packages and choices with seamless navigation on the Web.
- Finding additional ways to communicate with international constituencies.

More will have to be done to take advantage of extensible markup language and other Web services capabilities. The development of extensible markup language (XML) creates a challenge because

participation in setting standards and structures must be done well in advance of use. The federal government has tended to lag and risks losing the ability to easily build on systems in their early years.

The long lead time in increasing the capacity to provide IP addresses in the United States could mean an important bottleneck for NOAA by mid-decade. Contingency planning for issues that could arise would be appropriate.

The trend has been toward increasing availability of government information in response to greater consumer sophistication, populist demands and technological opportunities. The Post-September 11 environment, the Data Quality Act and computer security concerns are likely to lead to temporary and selective slowing of the trend. Nevertheless, the long-term trend of providing more information will remain intact and may even be enhanced by increased interest in civic issues after 9-11.

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In this effort a 5-10 year period of interest was indicated. For some NOAA issues it will be important to consider longer time frames.

Appendix A: Implications of Trends for NOAA by Function

Implications of Trends for NOAA by Function - Overview

(relative importance indicated by presence and size of x)

Trend	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Observing technologies and their platforms – sensors, satellites, unmanned ocean vehicles, etc.	X	X	x	x	X	X	
Communication technologies – broadband, wireless, Internet, etc.	X	X	X	x	X	X	X
Globalization	X	X	X	X	X	X	X
Climate change and climate change initiative	X	X	X	x	X	X	X
Government demands for services	X	X	X	X	X	X	X

Business and consumer demands for services	X	X	X	X	x	X	X
Business structure trends	X				x	X	X
Economic trends	X			X			
Budget climate	x	x	x	x		X	
"Smart regulation"	X	x	x	X	X	X	X
Ecosystem management	X	x	x	X	X	x	X
Increased regulatory responsibilities.	X	x	x	X	X	x	X
The President's Management Agenda	X				X	x	X
National and domestic security	X	X	x		X	X	X

Implications of Trends for NOAA by Function - Detailed

	Implications by Area						
Trend	**Mission and Vision**	**Observing Systems**	**Research and Prediction**	**Resource Management**	**Management and Human Capital**	**Infrastructure**	**Relationships with Other Organizations and the Public**
Rapid rate of technological change and innovation, including convergence of technologies and applications Key technologies include broadband, satellites, supercomputing, sensors, Web services, wireless communication and unmanned ocean and air vehicles.	Creates opportunities for increased role of science in decision-making Increases need for government to become more business-like. Rapid obsolescence creates a need for more rapid replacement and greater coordination of acquisitions and uses among NOAA units — including rethinking how things will get done when new	Combinations of technologies such as satellites and sensors with unmanned ocean and air vehicles create capabilities for global and integrated observing. Makes it possible to handle the massive increases in data that will be generated.	Revolutionary effects can be expected to come through cumulative impacts of evolutionary changes in and interactions of technologies. Advances in mathematics and supercomput-ing enable provision of climate and weather forecasts for detailed geographic areas. Revolutionary	Creates a climate that benefits from greater reliance on markets and more flexible regulation. Creates specific solutions such as nets that reduce bycatch, trawling methods for shrimp that reduce destruction of habitats and mapping technologies that identify habitats requiring protection. Assuring use of some of these technologies may require	Requires strong management at a level that facilitates cross-fertilization and integration of activities. Creates benefits from arrangements to move more rapidly from research findings to operations. Demands a greater range of disciplines and people with knowledge of the latest technologies. Creates greater	Increases the importance of responsive systems and policies for making technology decisions and keeping up with rapid change when obsolescence is high. Areas where keeping up with technology is an issue include: The explosive growth in satellite data. Opportunities to use Web	Creates a need to rely more on the private sector to provide some of the increased technological capabilities NOAA requires and to meet some of the financing and capital investment requirements. Requires capabilities to make information and services available in ways that meet the demands of a technologically sophisticated private sector that increasingly is a

	technologies are available and how the technologies complement, change or replace preexisting systems. Convergence of technologies also increases the need for coordination of acquisitions and uses among NOAA units.		changes also can be expected from evolutionary changes in technology that permit breakthrough discoveries. Discovery of El Niño and the Southern Oscillation. Discovery of the hole in the ozone layer.	regulation or funding demonstrations. However, also creates capabilities for greater destruction of habitats, such as through tools for finding and dredging, requiring further intervention. Opportunities for electronic consultation and rulemaking.	need for people capable of managing technology. Creates a need to deal with information overload on top managers. This typically involves delegation of responsibilities and decisions to decentralized units, which in turn requires attracting and developing personnel capable of management roles. Facilitates more flexible work arrangements.	services technologies in government. Requires development of new infrastructure for unmanned ocean vehicles and other new systems, along with adapting the role of the NOAA fleet. More competition among technology standards lengthens time to agreement but potentially allows better choice of standards. Need for active and early participation in standard-setting processes to fully benefit from outcomes.	direct or indirect partner in serving end users. Creates opportunities for more extensive use of the Internet and other forms of electronic communication and commerce. Growth of broadband enables sharing of large data sets among organizations and researchers and providing streaming multimedia. Increased importance of science education.

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Globalization	Requires expanded and more systematic international efforts, including scientific and measurement support for international monitoring, research, negotiations and dispute resolution. Terrorism and war add new dimensions to international responsibilities. Global commitments require leadership and assuring that managers give serious attention to international responsibilities.	Increased attention will be required to: Global ecosystems. International cooperation. Demands related to international negotiations, boundary determina-tion and dispute resolution. Private and government information for navigation.	Demand for more global analyses, with geographic detail for more areas. Increased international demands for services relating to climate change, fish migration, military and relief efforts and international negotiations. Increased importance of international cooperation in research.	Increased acceptance of complementarity between the environment and economic development involves NOAA in development issues. Conflict with other nations over the degree of government intervention on climate change and other environmental issues.	Potential benefits for recruiting more people with language skills, people who have lived or worked in other countries and people who have dealt with international organizations. Possible benefits of rotational assignments with other countries and international organizations.	Need for resources for infrastructure development and maintenance to support global systems. Need to determine when new observing technologies can be cost-reducing. Locations of some activities may be far flung. Issues of how to manage the transition from current systems. Possibilities of international collaboration on satellites, ocean monitoring or other systems and sharing of data, e.g. from Chinese environmental satellites.	Globalization creates demand for services from government and private organizations with international involvements. Renewed U.S. reliance on multinational institutions and networks increases demands for NOAA participation and support. Potential to use the Internet for communication tailored to international scientific and policy audiences and publics.

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Climate change	Provides an opportunity to enhance NOAA's leadership in science and measurement 1) by its work, 2) by leading other agencies and organizations, and 3) by defining what information and research government as a whole should develop or cause to be developed. Requires support for large-scale scientific approaches and investments. Requires integration of efforts of many disciplines.	Makes global and integrated observing systems essential. Requires an ability to handle several orders of magnitude increases in the volumes of observational data from satellites and other systems which involve new generations of supercomputing and advances in mathematics.	Public concern, together with unwillingness to make great sacrifices, places a premium on: More complete and detailed explanation and prediction of climate change. Assessment of economic, demographic and social consequences of climate change. Research support for developing policies, especially those that are less costly and restrictive.	Opportunity to foster a strong scientific basis for policy throughout government. Increased demands for information to support regulation. Continuing tension between approaches that emphasize science and those that emphasize precautionary policies before scientific answers are available will put on pressure to provide results and scientific assessments at early stages of research.	Requires management and arrangements that cut across many areas of activity. Creates demand for more people capable of developing climate models—with a possible role for NOAA in creating or supporting arrangements for developing the skills.	Demands new generations of supercomputing and advances in mathematics. Potential role for NOAA in working with other agencies to encourage the development of later generations of high performance computing and encourage development of competing sources to prevent monopolization of high performance computing.	Requires extensive interagency and international cooperation. Requires coordinating capabilities of universities, research organizations and private companies with government efforts. Importance of the problem, the range or uncertainty and the potentially far-reaching responses creates a heightened need for public education.

			Will result in demands for NOAA to assess impacts of efforts to address global warming. Requires integration of efforts of many disciplines.				

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Government, business and consumer demands for services	Demands for more global and more local information. Increased demands from other government agencies. Increased international demands, including: Military, including information support for changes in military structure and force posture, domestic security, origin and spread of contamina-tion, missile	Increased public and business demands for weather and climate information and information on pollution and marine developments. International demands for information. Increased government demands related to security, economic development and relief, global developments in marine life.	Demands for more accurate prediction of weather and climate change. Demands for more local weather and climate data. Interest in air quality measures and warnings.	Demands for more science addressing the merits of regulations, including demands for more social science capabilities.	Requires internal organization and increased skills to manage expanded and more complex relationships with external organizations.	Need to maintain modern interfaces to accommodate users of information. Potential for public and private inter-organizational development of Web and other electronic services.	Demands for greater and earlier coordination with commercial firms when new services are introduced. Demands for greater international cooperation in data and research. Increased demands for information from the public and increased need for public education, satisfied through a wider array of distribution means.

	defense. Economic development and relief efforts. Disputes over use of the oceans, delineating boundaries of the outer continental shelf, charting passageways for navigation, global develop-ments in fish stocks and other marine life.						

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Business, economic and budget climate	Growth of capabilities of the private sector to provide services that have been provided by government means that increasingly the question is not what government should do but what government should take responsibility for. Opportunities for NOAA to develop new types of relationships and act as a catalyst for initiatives to be fulfilled in the private sector.	Opportunities for new arrangements with the private sector as a result of changing organizational structures and capabilities. These may involve multi-firm organizations and a variety of possible roles. Greater competition for budgets with worsened budget balance. Increased demands for weather and climate information if higher energy prices.	Need for greater collaboration with universities and research centers to reach critical mass in numbers and range of skills and for and equipment for climate change science.	Economic development will put more pressure on coastal resources, domestically and internationally. Competition for water among communities and among uses will become more contentious.	Long-term shortages of technical skills and difficulty of government competing with the private sector for technical personnel require creating a desirable climate in NOAA.	Increased bandwidth and private sector capabilities facilitate off site location and contracting out of supercomputing. Competition reduces opportunities for sustained technological monopolies. However, shakeouts from competition, combined with restrictions on procurement, can create new monopolies (e.g. in supercomputing).	Opportunities to take advantage of innovation and resources of the private sector to respond rapidly to change, keep up with technology and utilize private capital.

	Mission and Vision	Observing Systems	Research and Prediction	Resource Management	Management and Human Capital	Infrastructure	Relationships with Other Organizations and the Public
Environmental and resource management policies **Trends include:** Global change initiative "Smart regulation" Ecosystem management Local approaches Technological solutions Data Quality Act Economic development as complementary to the environment Rejection of the "precautionary principle"	Potential for the combination of upcoming legislative reauthorizations, activities of the two ocean commissions and changes in Congress and/or the White House to produce much more fundamental legislative and policy change than is widely expected. Change also can come from leadership by NOAA. NOAA will be asked to provide more information and analysis to support regulation and could see expanded	Increased demand for ecosystem information. Demand for more global and more local information. Increased collection of air quality information.	Opportunities to foster the role of science in regulation. Opportunities to advance knowledge, utilizing data from global and integrated observing systems. Need for research to understand ecosystem interrelationships and responses to changes Increased analysis of air quality information and development of products.	Ecosystem approach Makes strong demands on internal and inter-organizational coordination. Requires extensive international involvement and cooperation. Requires integration of efforts of many disciplines. "Smart regulation" will require efforts to apply tools such as cost-benefit analysis,	Requires integration of efforts of many disciplines. Requires more management personnel with skills in both management and science. Requires greater capacity and coordination at the regional and local level. Requires structures to manage regulatory initiatives and rules and procedures.	Requires local operations offices with science capabilities.	Requires efforts to organize and support new governance structures (e.g. for fisheries management councils and ocean stewardship) and incentive systems.

	regulatory roles in fisheries, oceans and the beginnings of regulatory roles relating to climate change. Growth of regulatory responsibilities requires greater efforts at managing relationships between science and regulation. Growth of regulatory responsibilities requires integration of efforts of many disciplines.			incentive systems such as tradable permits, contracting, determining geographic scope, and developing governance and participation arrangements for self-regulation, more systematically. Need to evolve "smart regulation" approaches on an ecosystem scale. Need to resolve environmental issues relating to military facilities and activities, including training, encroachment of the surrounding environment and the military request for exemption to the Endangered Species Act.			

	Mission and Vision	**Observing Systems**	**Research and Prediction**	**Resource Management**	**Management and Human Capital**	**Infrastructure**	**Relationships with Other Organizations and the Public**
Government initiatives Initiatives include: The President's Management Agenda Environmental and resource management policies Ocean policy review War on terrorism, homeland security and disaster preparedness and response Changes in military structure and force posture	Need for a more systematic effort to interface with universities, research organizations and private firms. Opportunities for greater contracting with private organizations. Opportunities for public and private interagency cooperation in Web and other electronic services.	Anti-terrorism and military efforts create: Increased demands for international information. Demands for ability to determine sources and paths of chemical, biological and nuclear releases. Demands for internal protections and responses. Demands resulting from changing military structure and	The Data Quality Act can delay and/or complicate release of findings.	Growing regulatory responsibilities Require greater efforts at managing relation-ships between science and regulation. Require greater coordina-tion of NMFS and NOS activities. Will require both more interna-tional *and* more local efforts. Will involve	Requires greater coordination of ocean policy, legislation, regulation and operations. Requires greater interagency coordination. Increased capabilities required for management of outsourcing.	Need for coordination and reevaluation of uses of NOAA vs. other agencies' facilities, including substitution and cooperative arrangements.	Increased interagency responsibilities.

		structure and force posture to support rapid response. Demands for outsourcing to improve government efficiency. Increased scrutiny of release of information for security implications.		increased reliance on new approaches such as "smart regulation" and efforts to apply and adapt those approaches systematica lly Will require more personnel that have both science and manage-ment skills.			

Hudson Institute Study Team

Irving Leveson

Adjunct Senior Fellow and Chief Economic Consultant

Irving Leveson, Principal Investigator, is an expert in economic, financial and business analysis, strategy consulting and public policy. Dr. Leveson combines understanding of critical issues and trends with extensive experience dealing with practical business problems. He uses his knowledge to assist leading organizations on a wide range of domestic and international issues and decisions.

Dr. Leveson has worked for both business and government and addressed complex social and technological as well as economic issues. Dr. Leveson has been President of Leveson Consulting since 1990. He formed ForecastCenter.com in 1999 to disseminate forecasts and analyses to business and professional audiences. From 1984 to 1990 Dr. Leveson was Senior Vice President and Director of Research of Hudson Strategy Group, a consulting firm that was part of Marsh & McLennan.

Dr. Leveson served as Director of Economic Studies of Hudson Institute from 1977-84 and Senior Professional Staff at Hudson from 1974-77. He also has worked at the RAND Corporation, the New York City Planning Commission and the National Bureau of Economic Research.

Dr. Leveson received his Ph.D. in economics from Columbia University in 1968. His publications include *American Challenges: Business and Government in the World of the 1990s*, Praeger Publishers, 1991 and *Western Economies In Transition* (co-editor), Westview Press, 1980.

Charles Horner

Senior Fellow

Prior to joining Hudson Institute in January 1996, Charles Horner was president of the Madison Center, a public policy organization in Washington, D.C. During the Reagan and Bush administrations, he served consecutively as deputy representative to the United Nations Conference on the Law of Sea, deputy assistant Secretary of State for Science and Technology, and associate director of the United States Information Agency.

Horner has been a member of the adjunct faculty of Georgetown University's School of Foreign Service, an associate of its Landegger Program in International Business Diplomacy, and a member of the International Institute for Strategic Studies. He served on the staff of the late Senator Henry M. Jackson and then as senior legislative assistant to Senator Daniel P. Moynihan. Horner did graduate work in Chinese history at the University of Chicago and at Tokyo University. He also has served as adjunct professor of politics at Washington and Lee University.

Horner has served on several panels: the Secretary of State's Advisory Committee on International Communications and Information Policy; the Secretary of Commerce's Advisory Committee on the National Oceanic and Atmospheric Administration; the Voice of America's Advisory Committee; and the Advisory Board of the U.S. Merchant Marine Academy. By presidential appointment, Horner also was a

member of the J. William Fulbright Foreign Scholarship Board, which is responsible for the selection of all Fulbright grantees and for the supervision of the Fulbright program worldwide.

Kenneth R. Weinstein

Vice President and Director, Hudson Institute Washington Office

Weinstein has held key positions at numerous Washington, DC-based non-profit educational organizations, including as Director of the Government Reform Project at the Heritage Foundation, Director of Research at the New Citizenship Project and a Research Fellow at Hudson Institute. Prior to joining Hudson, Weinstein served as Director of the Washington Office for the Shalem Center, an educational and research institute with offices in Jerusalem and Washington, DC dedicated to Jewish social thought and Israeli public policy.

Weinstein holds a B.A. in General Studies in the Humanities from the College of the University of Chicago, an M. Phil. in Soviet and Eastern European Studies from the Institute d'Etudes Politiques de Paris and a Ph.D. in Government from Harvard University. His book reviews and articles on public policy topics have appeared in over one hundred publications, most notably the *New Republic*, the *Wall Street Journal*, and the *Weekly Standard*.

In addition to his public policy work, Weinstein writes and lectures regularly on topics in political philosophy. His articles and translations have been published by several academic presses, most notably, Lexington Books and the Princeton University Press. Weinstein also has served as Adjunct Professor of Government at Georgetown University where he has taught political philosophy.

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Initiative: Hudson works to counsel and guide policy change, applying our ideas whenever possible alongside other leaders in communities, businesses, non-profit organizations and governments alike.

Impact: Hudson reflects constantly on the application of our ideas, using real-world experience and new knowledge to improve the Institute's response to policy challenges.

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